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RESIDENTIAL FUELWOOD DEMAND ASSESSMENTS

A

STATUS

REPORT

OCTOBER 15, 1981

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CHUNG M. CHEN
FOREST INVENTORY & BIOMASS ANALYSES
GROWTH & MANAGEMENT DECISION MODELLINGS
WOOD PRODUCT PRODUCTION COMPUTER ANALYSIS

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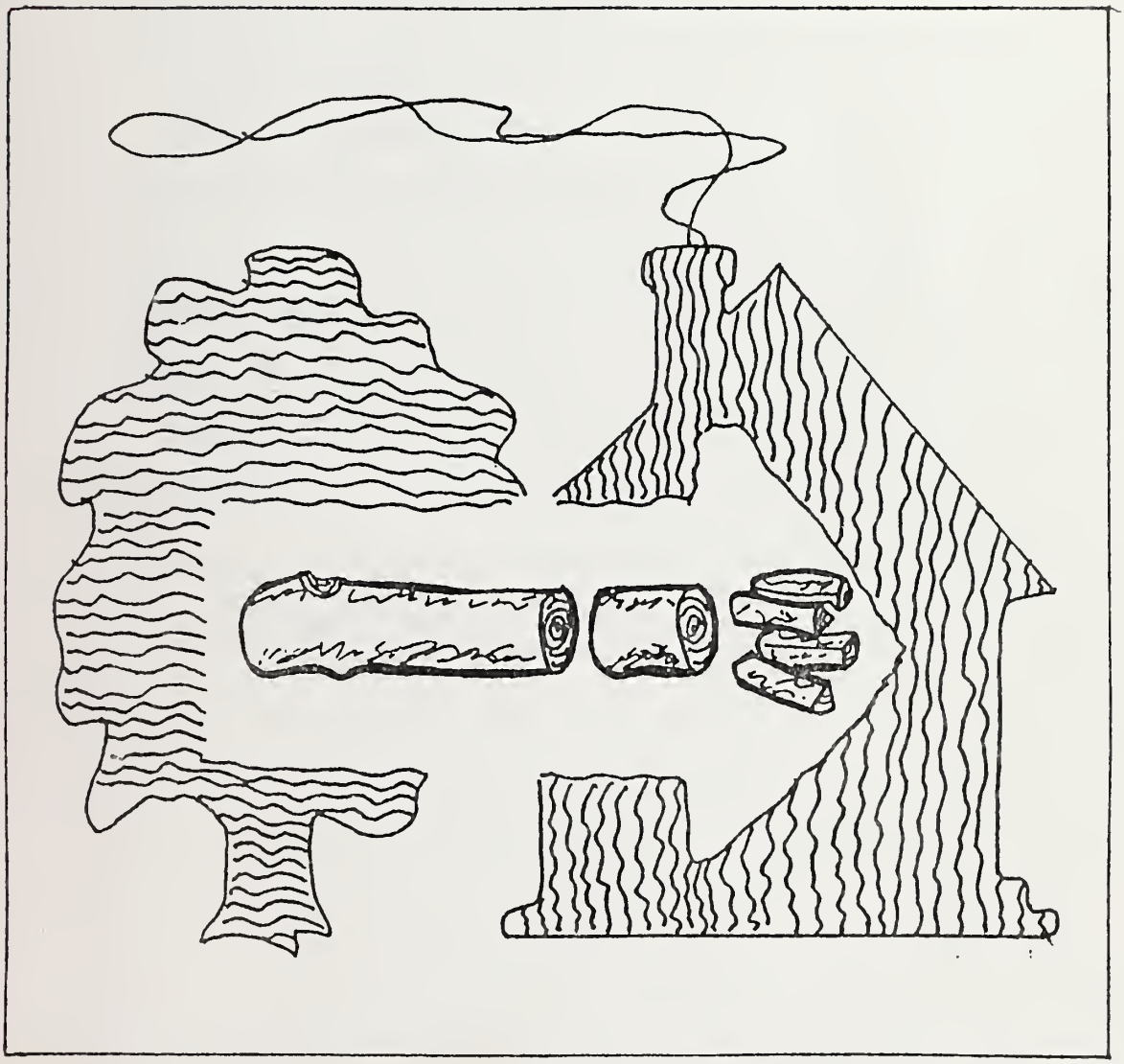
Residential Fuelwood

Demand Assessment



A cooperative project between the Northeastern Area State and Private Forestry, the Minnesota DNR Biometrics and Utilization staff, and participating states.

U.S.D.A., NAL
Cataloging Prep

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FUELWOOD ASSESSMENT PROGRAM

Introduction

In a cooperative effort, State and Private Forestry's Resource Use Staff and the Biometrics Unit of the Minnesota Department of Natural Resources have developed a Fuelwood Assessment Program. This program is designed to measure the consumption of fuelwood (in cords) used for residential heating on a state-wide basis. The program consists of a state wide telephone survey based on the number of households and regions within the state. A standard form is used for the phone survey questionnaire which is adaptable to all states (see appendix, pages 20 and 21). Modifications of the questionnaire are possible allowing a degree of flexibility in the survey.

Within the past three years Fuelwood Assessments have been completed in the states of Minnesota, Missouri, Wisconsin, Michigan's Upper Penninsula, New Jersey, Maryland and New York with more states scheduled this year. Basic survey procedures are summarized in this report with more detailed procedures included in the appendix for those interested.

Information Derived From Printout

Once the survey is completed, the questionnaires are computer analyzed with the information from the survey listed on two computer printouts.

The information derived from the printout is based on survey units, with each state being divided into a maximum of nine units. Generally, these units correspond to the Forest Service Inventory Units plus the major metropolitan regions. Information is also given according to usage classes (major, secondary or recreational source of heat), and burning facility (stove, regular fireplace, modified fireplace, furnace, or a combination of these).

The data in the printout is listed in table and pie distribution form. The following is a list of tables found in the printouts.

* Tables for sample volume only

- Sample volume statistics containing the average volume of wood burned, the standard deviation, minimum and maximum cord values, standard error of the mean, total volume variance and coefficient of variation for each unit and burning class.

- Sample volume statistics containing the average volume of wood burned, the standard deviation, minimum and maximum cord values, standard error of the mean, total volume variance and coefficient of variation for fuelwood cut by source and survey unit.

- Sample volume statistics (same statistics as above) for residence and second home by survey unit by type of wood (roundwood verses industrial waste).

- Sample volume statistics (same statistics as above) for fuelwood used for pleasure from major source of heat and supplementary source of heat and supplementary source of heat.

- Sample volume statistics (same statistics as above) for fuelwood cut by ownership and survey unit.

- Number of samples that used fuelwood by survey unit and use class.

- The length of period in which user burned fuelwood by unit and use class.

Total sample volume used for first home by survey unit.

Total sample volume used for second home by survey unit.

Total sample volume (first and second homes) by unit in cords.

- Pie distribution of volume used for first home by unit.
- Pie distribution of volume cut by survey unit.
- Pie distribution of volume purchased by survey unit.
- Pie distribution of volume grouped by facility.
- Pie distribution of volume for first home by use classes.

- Frequency bar chart of number of phone calls used fuelwood by unit.
- Frequency bar chart of sample volume by burning facility.
- Frequency bar chart of sample volume for first home by tree length classes.

Other tables describing distribution of phone calls as they relate to volumes, tree length, burning class, etc.

* Tables for expanded data for entire state include:

- Estimated total represented households burned fuelwood
- Estimated total fuelwood volume (in cords) used for first home heating.

- Total volume estimated (in cords) by species and use class for each survey unit.
- Total facilities used by facility and use class for each survey unit.
- Total households planning to install facilities by survey unit.
- Total cords used for first home.
- Total households used wood for second home.
- Total combined volume.

* For examples of tables taken directly from the printout, check in the appendix.

State and Federal Responsibilities

Since the fuelwood assessment is a cooperative effort, the participating state, State and Private Forestry and Minnesota Department of Natural Resources have specific responsibilities.

State and Private Forestry will provide:

1. The services of a technician to assist in the selection of phone numbers and to train the interviewers. The technician spends two weeks at the state forester's office.

2. The questionnaires are provided by State and Private Forestry -- Flexibility is built into the program: State and Private Forestry will try to satisfy the states need based on cost and time constraints.

Participating States will provide:

1. A current population census of the state with figures for the number of households.

2. Recent editions of phone directories used in the state.

3. Hire interviewers to work between the hours of 6:00 to 9:30 pm. Forestry students are well suited to work on this project. Touch phones are much faster than conventional dial models. Also, the interviews go smoother if each interviewer is placed in a separate office.

4. States need to insure access to their WATTS line during evening hours.

Minnesota Department of Natural Resources will provide:

1. Dr. Chen of Minnesota Department of Natural Resources will apportion the sample size by unit and county. States are averaging 2,000 - 2,500 calls thus far.

2. Card punching, verification, computer time and printing of tables will be done on a cost basis for participating states.

Cost

The total cost of a Fuelwood Assessment is approximately $6,000 varing on the number of samples needed and modification of the questionnaire. Detailed cost information is in the Appendix (pages 25, 26, and 27).

Sampling Techniques

The fuelwood assessment is a statewide phone survey dependent on the number of households within the state. The current population census is used to determine the sample size. However, the number of samples depend on many factors. See appendix (page 22) for details on sample size collection and an example using Minnesota's survey.

Stratified random sampling has been used in past surveys to collect the phone numbers. The phone numbers, based on the sample size, are drawn from the current phone books with all duplicated books and numbers eliminated. Only residential households are called.

If a number is busy or no answer the next number down is called until a household is contacted. The selection of phone numbers is a lengthy part of the survey. The technician will take between 2 and 7 days to complete phone number selection depending upon number of books and duplications. (For detailed phone number collection procedures see appendix pages 23 and 24.)

Once the phone numbers have been selected the interviewers begin calling. On the average, each interviewer will make approximately 10 calls an hour with each interview lasting approximately six minutes. Calling will take between two and three weeks depending on the number of interviewers. Accuracy statistics from the survey for state wide figures will be at the 95% level of confidence; unit statistics will exceed the 90% level of confidence.

Results

The data included in this section from the states of Minnesota, Wisconsin, Michigan, Missouri, New Jersey, Maryland and New York, have been condensed from the computer printouts. Data is listed in table for with the survey units totaled giving statewide statistics. The sample size, number of households within the state, number of households using fuelwood, and the volume (in cords) of fuelwood consumed is summarized in the first table of data.

Tables 1 thru 7 summarizes data from all 8 studies. The information collected from these tables have shown some similarities among the states. Some of these similarities are listed on the following page:

Approximately 25.3% (wtd mean) of the households within each state use fuelwood for residential heating with 3.0% of the households of the seven most recent studies (MI not included) planning on installing facilities in the near future. On the average, 77.1% of wood burned was cut by the residents themselves with 22.9% purchasing their fuelwood.

In these most recent studies, households cutting wood tend to get firewood off private land (88%) from dead standing trees (58%). The majority of the rest of the trees came from live standing trees (23%), with logging residue, rural and agricultral land clearing and residential land clearing (6%) accounting for the rest of the volume. Six percent of firewood comes from state land and 6% from federal, county and others. This low figure of firewood from state land may be affected by a small number of firewood permits available from state land. During the interviews, the public commented they tried, and would like, to get a firewood permits but weren't able to get one.

When comparing the estimated number of facilities for each state (all eight studies analyzed), 61.6% of the people use a regular or modified fireplace, 23.3% use a stove, and 4.6% use a furnace to heat their homes. The other categories (stove and regular fireplace, stove and modified fireplace, stove and furnace, fireplace and furnace) make up the other 10.5%. Of the households planning to install burning facilities (MN 1980, NY, NJ, MD only) 33% will be installing stoves, 28.6% regular fireplaces, 15.7% modified fireplaces and 10.0% furnaces.

In eight studies that are completed, (MI not analyzed), hardwood made up 96.5% of the sample volume (wtd. ave.), with 3.5% being softwood. The type of wood utilized depends on the availability of a species within the state. Oak has ranked high in species use, however a higher percentage of burners use a variety of hardwoods not being able to distinguish the difference between species.

GENERAL RESULTS FROM 8 RESIDENTIAL FUELWOOD STUDIES (1979 - 1981)

	MN (1979)	MO (1980)	WI (1980)	MN (1980)	MI/UP(1980)	NJ (1981)	NY (1981)	MD(1981)
Sample Size	2042	2370	2232	2157	398	2518	2496	2702
Households	1,218,983	1,650,171	1,681,839	1,445,616	34,920	2,667,490	6,339,762	2,072,102
Households Used	354,729	499,938	485,828	479,104	14,828	613,276	1,319,008	569,001
	29.1%	30.3%	28.9%	33.1%	42.5%	23.0%	20.8%	27.5%
Volume Consumed								
1st home	883,136	1,282,136	1,345,187	1,306,593	83,310	986,680	3,245,415	942,037
2nd home	16,040	51,133	26,258	61,313	1,465	15,088	142,855	29,180
combined	899,176	1,333,268	1,371,445	1,367,905	84,775	1,001,769	3,388,270	971,217
Sample #	1,296	1,571	1,616	1,706	697	753	1,904	1,198
Volume Cut %	85.3%	74.2%	82.2%	85.8%	73.4%	68.5%	69.4%	70.0%
Sample #	223	427	350	282	252	347	840	509
Volume Purchased %	14.7%	20.2%	17.8%	14.2%	26.6%	31.5%	30.6%	30.0%

TOTAL HOUSEHOLDS PLANNING TO INSTALL FACILITIES
FOR 8 RESIDENTIAL FUELWOOD STUDIES (1979-1981)

State	Type of facility the plan on installing	Number of households	Percent of total	Estimated overall % of population plan on installing
Minnesota (1979)	Stove	4,392	.4	
	F.	5,893	.5	
	Fn.	4,726	.4	
TOTAL		15,011	1.3	1.3
Missouri (1980)	Stove	29,547	1.8	
	R.F.	17,450	1.1	
	Fn.	5,899	.4	
TOTAL		52,896	3.3	3.3
Wisconsin (1980)	Stove	15,625	.9	
	F.	5,748	.3	
	Fn.	20,693	1.2	
TOTAL		42,067	2.4	2.4
Minnesota (1980)	Stove	20,514	39.4	
	R.F.	7,358	14.1	
	M.F.	7,740	14.9	
	Fn.	7,405	14.2	
	S.R.F.	3,309	6.3	
	S.M.F.	1,346	2.6	
	S.Fn.	3,161	6.1	
	F.Fn.	1,250	2.4	
TOTAL		52,083	100.0	3.6
New Jersey (1981)	Stove	33,459	31.7	
	R.F.	57,004	54.2	
	M.F.	7,218	6.9	
	Fn.	536	.5	
	S.R.F.	7,188	6.8	
TOTAL		105,405	100.0	4.0
New York (1981)	Stove	62,961	34.7	
	R.F.	32,734	18.0	
	M.F.	32,827	17.5	
	Fn.	28,310	15.6	
	S.R.F.	13,994	7.7	
	S.M.F.	3,852	2.1	
	S.Fn.	6,442	3.5	
	F.Fn.	1,584	.9	
TOTAL		181,704	100.0	2.9
Maryland (1981)	Stove	8,446	18.0	
	R.F.	21,315	45.4	
	M.F.	12,206	26.0	
	Fn.	731	1.6	
	S.R.F.	4,227	9.0	
TOTAL		46,925	100.0	2.3

TOTAL HOUSEHOLDS, VOLUME, AVERAGE VOLUME PER USER FOR EACH STATE BY USE CLASS

STATE	CLASS 1 Major source of heat	CLASS 2 Secondary source	CLASS 3 Aesthetic reasons	CLASS 4 Major source of heat and aesthetic reasons	CLASS 5 Secondary source of heat and aesthetic reasons
Minnesota (1979)					
Total households	58,220	115,086	109,098	1,967	70,358
Total volume	368,925	323,386	69,430	13,538	107,857
Ave. vol. per user	6.3	2.8	.6	6.9	1.5
Missouri (1980)					
Total households	118,720	213,788	135,784	1,186	30,460
Total volume	607,613	452,931	171,933	3,431	46,228
Ave. vol. per user	4.8	2.2	1.5	3.5	1.7
Wisconsin (1980)					
Total households	128,539	163,623	146,730	2,448	44,488
Total volume	835,324	338,465	92,665	11,791	66,942
Ave. vol. per user	6.5	2.4	.8	4.8	1.5
Michigan/Upper Pennisula (1980)					
Total households	4,809	5,966	439	88	526
Total volume	56,269	24,004	544	880	1,613
Ave. vol. per user	7.2	4.0	1.2	10.0	3.1

TOTAL HOUSEHOLDS, VOLUME AND AVERAGE
VOLUME PER USER FOR EACH STATE BY USE CLASS

STATE	USE CLASS		
	Major source of heat	Supplement source of heat	Pleasure
Minnesota (1980)			
Total households	119,500	189,370	170,234
Total volume	728,553.9	457,235.5	120,802.7
Ave. vol. per user	6.1	2.4	.7
New Jersey (1981)			
Total households	92,027	298,349	222,900
Total volume	300,507.1	485,737.9	200,435.5
Ave. vol. per user	3.3	1.6	.9
New York (1981)			
Total households	302,285	566,784	489,939
Total volume	1,639,731	1,274,063	331,621.6
Ave. vol. per user	5.4	2.25	.7
Maryland (1981)			
Total households	84,756	272,763	211,482
Total volume	346,311.9	442,710.7	153,015.2
Ave. vol. per user	4.1	1.62	.7

NUMBER OF SAMPLES AND VOLUME (IN CORDS) FOR EACH POPULATION UNIT FOR EACH STATE

STATE	UNIT 1	UNIT 2	UNIT 3	UNIT 4
Minnesota (1979)				
# of samples used fuelwood				
Volume in cords				
Missouri (1980)				
# of samples used fuelwood	348	91	65	258
Volume in cords	1259.2	262	166.9	390.6
Wisconsin (1980)				
# of samples used fuelwood	230	113	199	112
Volume in cords	997.4	457.9	387.4	124.5
Minnesota (1980)				
# of samples used fuelwood	218	137	247	114
Volume in cords	1006.5	425.6	456.1	100.2
Michigan/Upper Pennisula(1980)				
# of samples used fuelwood	129	40		
Volume in cords	757.4	192.1		
New Jersey (1981)				
# of samples used fuelwood	62	200	353	13
Volume in cords	146.7	378.3	559.8	16.3
New York (1981)				
# of samples used fuelwood	258	186	258	57
Volume in cords	1238.4	754.5	674.1	77.7
Maryland (1981)				
# of samples used fuelwood	295	98	279	148
Volume in cords	862.4	231.4	469.6	144.7

Pop Unit 1 = Rural, less than 2,500

Pop Unit 2 = Small town 2,500 - 10,000

Pop Unit 3 = Large town 10,000 - 100,000

Pop Unit 4 = Very large town more than 100,000

TOTAL ESTIMATED VOLUME (IN CORDS) BY SPECIES AND FACILITY FOR 8 RESIDENTIAL FUELWOOD STUDIES (1979-1981)

MINNESOTA (1978-79)

Species	Volume	Percent
Mapl	52,538	6.0
Oak	216,728	24.5
Bir	133,260	15.1
Elm	87,849	9.95
Ash	50,170	5.7
Aspen	76,366	8.7
Tam	2,780	.3
Pine	15,752	1.8
Spru	832	.1
Other	17,953	2.0
Mish	228,907	25.9
TOTAL	883,135	100.0

Facility	Volume	Percent
Stove	107,897	30.4
F.P.	205,758	58.0
Furn.	18,643	5.3
FP&Stove	13,418	3.8
FP&Furn.	4,135	1.2
Furn&Stove	2,949	.8
Stove,RF, & Furn.	1,927	.5
TOTAL	354,727	100.0

MISSOURI (1980)

Species	Volume	Percent
Oak	570,439.1	44.5
Elm	68,916.5	5.4
Ash	19,188.6	1.5
Hick	77,187.1	6.0
Other Hwd.	543,036.1	42.3
Pine	3,367.6	.3
TOTAL	1,282.136.0	100.0

Facility	Volume	Percent
Stove	131,830	42.0
F.P.	304,568	37.3
Furn.	21,125	9.0
FP&Stove	34,277	9.4
FP&Furn.	1,683	.8
Furn&Stove	1,756	.5
Stove, RF & Furn.	4,704	1.0
TOTAL	499,943	100.0

WISCONSIN (1980)

Species	Volume	Percent
Mapl	72,258	5.4
Oak	31,317	23.3
Bir	84,272	6.3
Elm	189,551	14.1
Ash	4,159	0.3
Aspen	11,399	0.8
Tam	333	0.02
Pine	10,960	0.8
Spru	127	0.01
Other	42,488	3.1
Mish	616,522	45.8
TOTAL	1,345,186	100.0

Facility	Volume	Percent
Stove	136,269	42.7
F.P.	239,619	15.0
Furn.	61,734	24.0
FP&Stove	20,940	6.6
FP&Furn.	16,571	5.2
Furn&Stove	8,005	4.5
Stove, RF, &Furn.	2,694	2.0
TOTAL	485,832	100.0

MICHIGAN (1980

NONE FOR MICHIGAN

Facility	Percent Volume
Stove	56.7
F.P.	2.3
Furn.	21.0
FP & Stove	10.7
FP & Furn.	2.6
Furn & Stove	6.7
TOTAL	100.0

Minnesota (1980)

Species	Volume	Percent
Oak	291,718.6	22.3
Birch	149,618.0	11.5
Ash	106,024.3	8.1
Elm	194,869.2	14.9
Maple	47,347.6	3.6
Aspen	99,501.7	7.6
Basswood	2,054.1	.2
Mixed Hwd.	390,769.7	29.9
Pine	18,446.0	1.4
Spruce fir	687.8	.1
Mixed soft wood	5,556.6	.4
Total	1,306,592.0	100.00

Facility	Estimated # of fac. for entire state	% of sample volume burned in facility
Stove	153,386	48.6
R.F.	173,873	11.3
M.F.	87,333	10.2
Furn.	29,397	14.7
S. R.F.	13,302	5.2
S. M.F.	8,831	3.1
S. FN.	6,169	3.3
F. FN.	6,813	2.6
Total	479,104	100.0

New Jersey (1981)

Species	Volume	Percent
Oak	357,394.6	36.2
Birch	8,086.5	.8
Ash	13,458.9	1.4
Elm	6,108.4	.6
Maple	62,614.6	6.3
Aspen	472.6	.1
Basswood	8,701.9	.9
Mxd. Hdwd.	461,457.2	46.8
#1 Cherry	33,392	3.4
#2	313.6	0.0
#3	619.1	.1
Pine	21,494.6	2.1
Spruce Fir	72.2	0.0
Mxd sftwds.	12,493.8	1.3
Total	986,679.7	100.0

Facility	Estimated # of fac. for entire state	% of sample volume burned in facility
Stove	113,243	35.16
R.F.	423,965	46.62
M.F.	37,581	6.98
Furn.	2,839	
S. R.F.	32,108	9.93
S. FN.	1,180	all total
F. FN.	1,359	1.32
Total	613,275	100.00

New York (1981)

Species	Volume	Percent
Oak	450,903.1	13.9
Birch	65,048.5	2.0
Ash	159,279.7	4.0
Elm	162,714.3	5.0
Maple	475,423.2	14.7
Aspen	9,610.8	.1
Baswood	141,082.4	4.4
Mxd. Hdwd.	1,303,321.0	40.2
Beech	227,488.7	7.0
Cherry	92,036.1	2.8
Apple	17,923.4	.6
Pine	27,602.0	.9
Spruce fir	5,769.7	.1
Mxd. sftwds.	107,212.7	3.3
Total	3,245,411.0	100.00

Facility	Estimated # of fac. for entire state	% of sample volume burned in facility
Stove	390,497	50.4
R.F.	670,319	13.2
M.F.	99,005	4.3
Furn.	57,957	15.2
S. R.F.	70,675	8.8
S. M.F.	7,299	4.3
S. FN.	17,126	5.6
F. FN.	6,126	2.2
Total	1,319,004	100.0

Maryland

Species	Volume	Percent
Oak	358,083.4	38.0
Birch	995.3	.1
Ash	194.2	.2
Elm	8,061.2	.9
Maple	23,618.5	2.5
Basswood	658.2	.1
Mxd. Hdwd.	422,428.1	44.8
Poplar	27,369.0	2.9
Locust	26,244.8	2.8
Hickory	8,332.0	.9
Pine	43,585.8	4.6
Sprucefir	427.0	.1
Mxd. sftwds.	20,291.0	2.1
Total	942,038.2	100.0

Facility	Estimated # of fac. for entire state	% of sample volume burned in facility
Stove	97,319	41.4
R.F.	344,758	23.7
M.F.	91,708	19.6
Furn.	5,804	4.3
S. RF.	23,917	6.1
S.M.F.	2,907	3.2
S. FN.	757	-
F. FN.	1,824	1.7
Total	568,994	100.0

Conclusion

The Fuelwood Assessment Program has gone well for the past three years. The questionnaire and computer printout has been modified to accommodate several suggestions from participating states. Presently Minnesota Department of Natural Resources is in the process of writing a final questionnaire form which should adequately cover each states need. A final computer program has been developed by Dr. Chen of Minnesota DNR which lists the data in a meaningful and informative way.

The possible uses of the Fuelwood Assessment Program are tremendous. By surveying a state every few years, a state will be able to establish trends in the use of firewood for residential heating. This program can be used as an efficient tool in planning firewood permit program from public lands or for estimating the volume (in cords) of wood which will be demanded in a future year for residential heating.

Private industry may be interested in the facilities used to follow the demand for wood burning facitlities. Logging operations may also be interested in knowing the percentages of households willing to buy logging residue to see if it may be profitable and feasible to start selling residue.

The possibilities of this program are vast. The information derived from the survey is important in determining on a state basis the volume of wood being consumed for residential heating.

APPENDIX

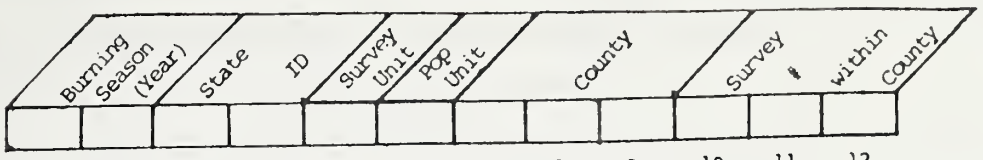
Office Use Only

RESIDENTIAL FUELWOOD DEMAND ASSESSMENT

Forestry 1/20/81

#

viewer



*1. Do you have facilities to burn wood? (1=yes, 2=no) ____ 13

*2. Did you burn fuelwood last year? (1=yes, 2=no) ____ 14

*3. Do you plan to burn fuelwood this winter? (1=yes, 2=no) ____ 15

*4. Have you recently installed or do you plan on installing wood burning facilities? (1=yes, 2=no) ____ 16

If answer "no" to all the above items, end interview

5. What type of facility do you have to burn wood?
Code: 1=stove 3=modified fireplace 5=1&2 7=1&4
2= regular fireplace 4=furnace 6=1&3 8=2 or 3, &4 ____ 17

6. Brand name of burning facility: ____

7. How many years ago did you first burn wood?
Code: (1=last year, 2=2 yrs, 3=3 yrs, 4=4-5 yrs, 5=6+ yrs) ____ 18

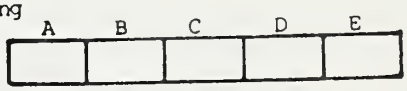
8. Do you burn wood as: (code one response only)
Code: 1=Major source of heat (primary heat source with another fuel for back-up)
2=Supplementary source of heat (used as back-up system)
3=For pleasure, ONLY ____ 19

9. If you burn wood for both heating and pleasure, what % of the volume of wood is burned strictly for pleasure? (leave blank if burn for pleasure only) ____ 20-21 %

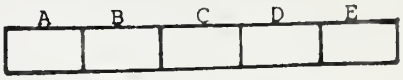
10. What % of your fuelwood do you cut yourself? (blank = 0%, 99 = 100%) ____ 22-23 %

11. If you purchase fuelwood, what length is the wood?
Code: 1=16" 3=4' 5=8' (or 100") 7=random/mixed roundwood 9=NOT purchased
2=2' 4=6' 6=tree length 8=random/mixed slabs, edgings ____ 24

12. If you cut fuelwood, what % of the volume is harvested from: (Round to nearest ten percent)
(A) Live, standing trees (B) Dead trees, standing or down
(C) Tops and trees remaining after logging (D) Rural and agric. land clearing
(E) Residential and Urban land clearing and tree removal
Code: (blank=0%, 1=10%, 2=20%, ..., 9=90 or 100%) ____ 25-29

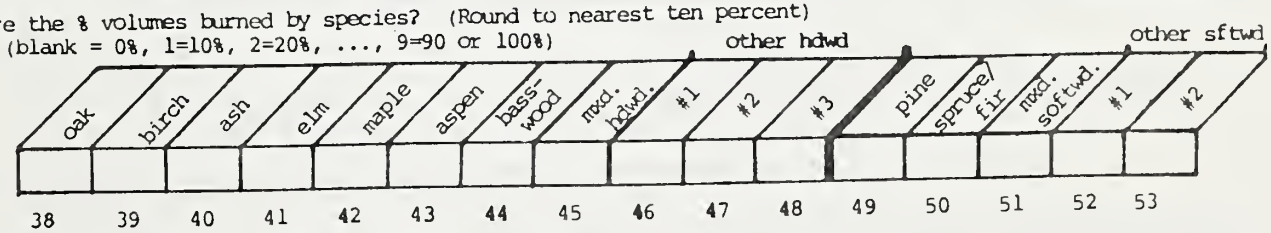


13. If you cut fuelwood, what % of the volume is harvested from:
(A) Private land (C) County land (E) Other/Don't know
(B) State land (D) Federal land
Code: (blank=0%, 1=10%, 2=20%, ..., 9=90 or 100%) ____ 30-34



14. If you cut fuelwood, what county is most of the wood harvested from?
County: ____ (name) ____ 35-37

15. What are the % volumes burned by species? (Round to nearest ten percent)
Code: (blank = 0%, 1=10%, 2=20%, ..., 9=90 or 100%)



16. Do you have a second home or other building where you burn wood?
(if no, leave blank) In which county? ____ (name) ____ 54-56

17. What volume of wood did you use last year, to the nearest 1/10 standard cord for each location and type of wood? (If none, leave blank)
Code: (i.e. 2.5 cords = 025, 3 cords = 030)

	Roundwood	Industrial Residue
Residence		
Second Home		

	Roundwood			Ind. Residue		
57-62						
63-68						

ITEM	COLUMN	REMARKS
:ice Use Only"	n/a	As each interview is initiated, record the phone # (including area code); initial and date each form. If any questions arise, they can more easily be resolved.
ning Season	1-2	This survey is for the 79-80 heating season, code "80".
ite ID	3-4	Each state is assigned a unique identification number. A list is attached (MN is code "27").
:vey Unit	5	Each state is divided into forest survey units. See attached map and list of counties.
pulation Unit	6	During interview, find out what town and county respondent resides. In some cases you may have to ask respondent. (1) = Rural, less than 2,500 population (2) = Small town, 2,500-10,000 population (3) = Large town, 10,000-100,000 population (4) = Very large town, more than 100,000 population See attached list with population figures.
:ounty	7-9	See attached list of towns by county, and county codes (In MN, column 7 = "0").
Survey # w/in Co.	10-12	This is an identification # for each interview. They will be numbered consecutively within county, and will be done just prior to keypunching.
Q 1 Q 2 Q 3 Q 4	13 14 15 16	These questions establish whether a respondent burns wood, or plans to burn wood in the future. The wording of Q 4 is dependent on the responses of the preceding questions. If they do not have facilities (Q 1 = no) ask "... do you plan ..."; if Q 1 = yes, ask "have you recently ...". If it is established that the respondent doesn't have facilities or didn't burn wood last year or intend to burn this year, end interview. If they recently installed equipment but didn't burn last year (Q 2 = no, Q 3 = yes) find out the type of facilities (Q 5 & Q 6) then end interview.
Q 5	17	A modified fireplace includes inserts, heat exchangers, etc., any equipment which has been added to a regular fireplace to increase the heating capacity.
Q 6	n/a	This item will not be coded, but should be obtained from respondent. If unknown, write "unknown".
Q 7	18	
Q 8	19	Code only ONE response. Probe for response. 1 = MAJOR: the main source of heat in the home, may have another fuel system for back-up purposes, more than 50% household heat from wood, 2 = SUPPLEMENTARY: wood is used as a back-up system, with another fuel providing the main source of heat, 50% or less of the household heat from wood. 3 = PLEASURE: this is the recreational burner - they may get some heating benefits, but do not rely on wood as heating system.
Q 9	20-21	If a person says they burn both for pleasure and heat it is important to determine the volume percentages of each. Determine the volume % of wood burned for recreational purposes (i.e. sitting around fire with company, popcorn, etc.) Probe for response.
Q 10	22	
Q 11	23	If respondent is unsure of length, probe for response. If still unsure, code as random length.
Q 12 Q 13	24-28 29-33	Do not leave any columns blank. Code municipal land as (E): other.
Q 14	34-36	If more than 1 county is identified, write both down on the form, but code the county where the majority of the wood is harvested. Probe for response (determine a nearby town or landmark if unknown). See attached county codes.
Q 15	37-52	Put the proper code in the appropriate box. Probe for response. If unknown, determine whether hardwood or softwood, then code as a mixed hardwood (col. 44=9) or mixed softwoods (col. 50=9). In MN, Col. 51 = TAMARACK.
Q 16	53-55	Probe for response, determine town or landmark if unknown. See attached county codes.
Q 17	56-67	Take care to get accurate measurements. Probe for response. If the volume in standard cords is unknown, record response in workspace provided and use conversion factors to code the volume in 1/10 cords. See attached conversion factors, additional factors will be developed as needed. for roundwood use 128 ft^3/cord

Number of Samples Needed for Fuelwood Demand Assessment

The number of samples taken for a statewide fuelwood assessment are dependent on many factors. The following are some of the more important factors in determining the number of samples needed:

(A) The amount of time and money available to complete survey,
(B) The level of accuracy desired,
(C) The expected level of variation among volume burned per user within use class,
(D) The expected percentage of households that burn wood,
(E) Method of sampling to be used.

The following is a formula for simple random sampling prior to a fuelwood survey in order to estimate the number of samples needed that burn wood in a use class statewide:

$$n \doteq \left(\frac{t \times \hat{CV}}{E}\right)^2$$

where: $\hat{CV}$ = sample Coefficient of Variation in percentage

$$= \frac{\text{sample standard deviation}}{\text{avg. cords per user who burn wood}} \times 100$$

t = students t-value ($t \doteq 2$ for sample size ≥ 30 and 95% confidence level)

E = desired level of precision in percent

There are 3 use classes in the 1981 survey form (1/20/81), including users who (1) burn wood as a major heat source, (2) burn wood as a supplementary heat source, and (3) burn wood for pleasure only.

Based on the Minnesota situation, the following assumptions have been made:

(A) An accuracy of 10% with a 95% level of probability desired,
(B) 75% CV, the variability between volume burned (cords/user) within each use class,
(C) The same CV within all use classes (for simplicity only),
(D) One-third of the households in the state burn wood,
(E) 5 survey units in the state.

$$n = \left(\frac{2 \times 75}{10}\right)^2 = 225 \text{ households that burn wood within a use class statewide}$$

In the Minnesota case, 225 households that burn wood are desired in each use class. There are 3 use classes, therefore,

$3 \times 225 = 675$ samples (households) that burn wood are needed statewide.

Since experience showed that an average of 1/3 of the households burn wood,

$675 \div .33 = 2{,}045$ total samples are needed statewide. This includes households that burn wood and those that don't burn wood.

Minnesota has 5 survey units, therefore,

$2{,}045 \div 5 = 409$ total samples are needed in each survey unit.

Note: The total samples needed in a survey unit can vary with the % of households that burned wood and the other factors mentioned above.

One way of deriving total samples needed for a survey unit is:

$$\text{Total samples needed for a survey unit} = \left(\frac{\text{Total \# of households in the survey unit}}{\text{Total \# of households statewide}}\right) \times \text{Total samples statewide}$$

If the calculated total samples needed for a survey unit is less than 200, we may want to take 200 samples for this low population survey unit.

Collection Procedures for Phone Numbers

1. Collect all current phone directories within the state.

2. Eliminate all duplicated books and numbers; eliminate all out of state numbers.

3. Estimate the total number of residential numbers in each book (See ruler method at end of section). Record the number of pages per book.

4. Determine the number of calls to be made from each book and the interval per call by the following equations:

   a) $\frac{\text{Total residential numbers in all books}}{\text{Sample Size}}$ = interval per call

   b) $\frac{\text{Number of residential phones per book}}{\text{Interval}}$ = number of calls needed from this book

   c) $\frac{\text{Number of pages per book}}{\text{Number of calls per book}}$ = interval per call for this book

5. The nth in the nth column, dependent on the interval per call, is selected for the call.

6. The information is taped to the front of each phone book. The interviewers only needs to check the number of calls per book with the interval on the front of the book and start calling.

"Ruler" Method

Through experience the simplist method to estimate total number of residential phones in a book is through the ruler method.

Using a ruler, count the number of phone entries per inch on a few pages. Multiply the average number of listings per inch by the number of inches per column, then multiply by the number of columns per page. This number represents the total number of entries per page.

Next, count all empty spaces and non-residential phone numbers on the same page. Subtract these non-residential numbers from the total number of entries per page. This gives the number of residential phone listings per page.

Find the number of residential phone numbers per page for at least 10 - 20 pages to get an average. Multiply this average by the number of pages in the book. When counting the number of pages per book, take care to subtract pages which contain advertisments and government county, city and state listings.

Other information needed:

The technician may need to acquire the following information for the use in the survey:

- listing of cities in alphabetical order, within counties with population figures.
- an address for respondents to write requesting more information concerning the Fuelwood Assessment.
- fuelwood and cord conversion sheets.
- other information the state may want, such as an address to write for information concerning firewood programs from state land.
- map of state divided into survey units showing individual counties.

Calling

- calls are usually made between 6:00 and 9:30 pm. Afternoons and weekends are optional calling times.
- questionnaires are completed for each answered call unless respondent has no knowledge of household affairs (ie. young children, baby sitter, etc.)
- if respondent is not familar with fuelwood, conversions are made.

Cost

The cost to each state will vary according to sample size, errors and modifications. The sample size for states thus far have varied between 2,000 - 2,500. The cost have been averaging $6,000.00. On the following page is an example of cost to a state requiring 2,400 calls. These costs should only be as an estimation of the actual cost.

Cost to Forest Service

Technician Salary	$ 800
Supervision	360
Technician Travel Expenses	925
Forms	35
TOTAL	$2,120

Cost to Participating State

Interviewers Salary	$1,875
Supervision	750
Computer Expenses	1,000
TOTAL	$3,625

The following is a detailed list of Minnesota DNR data processing expenses:

(Varies according to sample size)

	ITEM	COST
1.	Keypunch Records	$ 144.00
	Verification by Keypunch	144.00
2.	Data Sheet Compilation	100.00
	Error Checking (student worker)	
3.	Program Editing, etc.	300.00 - 690.00
4.	Computer Processing Costs	2.00

5.	Outputs	1.80
6.	Generation of Tapes and Discs	50.00
7.	Data Stored in Tape for Five Years	65.00
8.	Copies and Mail Costs	16.82
9.	Communication and Co-ordination	30.00
10.	Misc. Expenses	60.00
	TOTAL	$ 900.00 - 1,200.00 (depending on modifications)

MAJ.=MAJOR SOURCE OF HEAT, SEC.=SECONDARY SOURCE OF HEAT
REC.= FOR RECREATION/PLEASURE
C.V.=COEFFICIENT OF VARIATION,VARIABILITY OF VOLUME USED AMONG USERS

9:05 WEDNESDAY, SEPTEMBER

UNIT=U1 CLASS=MAJ.

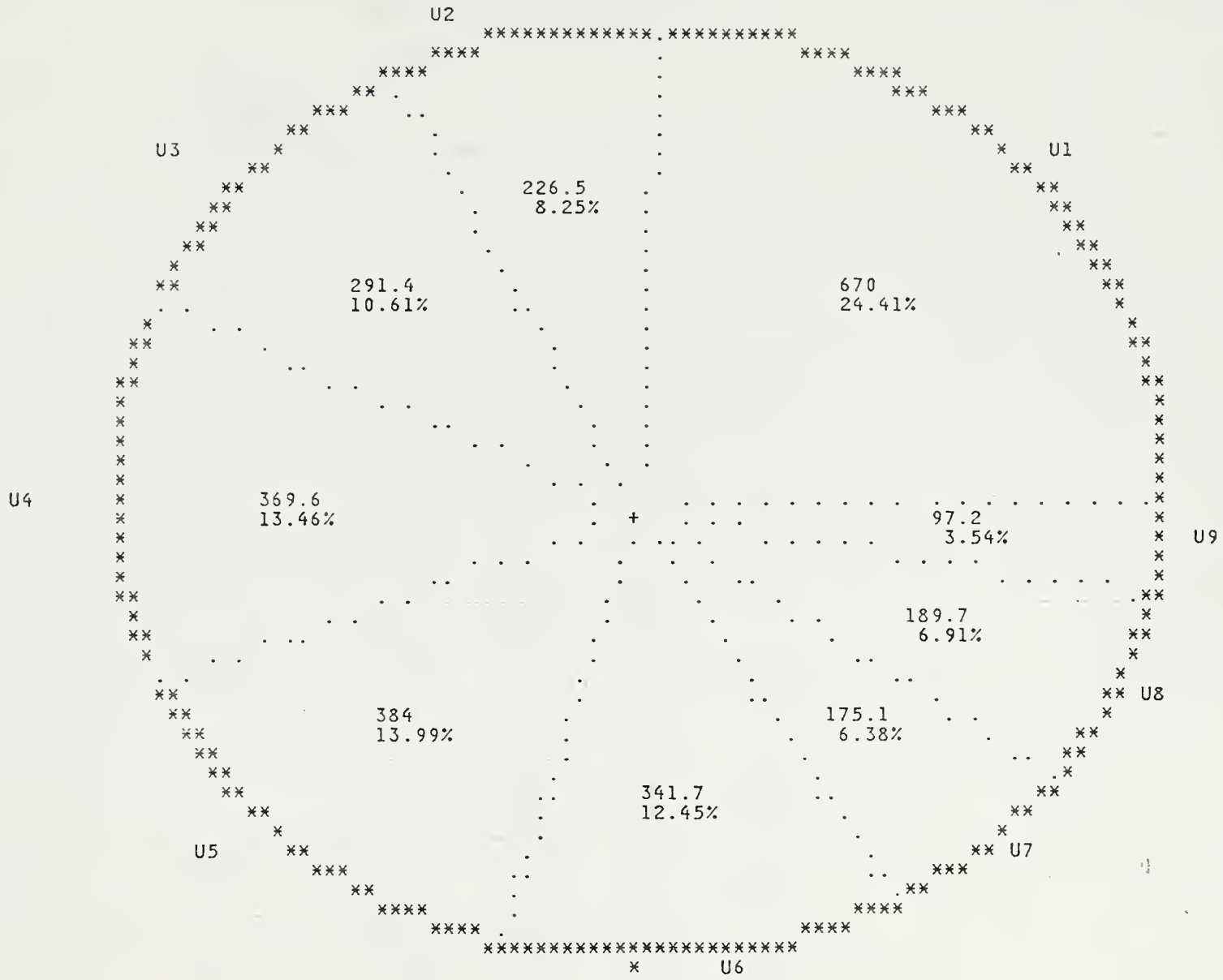
VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE
CORD	53	9.53396226	5.54686132	0.80000000	20.00000000	0.76192000	505.30000000	30.76767054
UNIT=U1 CLASS=REC.								
CORD	5	1.32000000	1.17770964	0.10000000	3.00000000	0.52668776	6.60000000	1.38700000
UNIT=U1 CLASS=SEC.								
CORD	35	4.51714286	4.08659831	0.20000000	15.00000000	0.69076119	158.10000000	16.70028571
UNIT=U2 CLASS=MAJ.								
CORD	18	4.93333333	1.63814817	2.50000000	9.00000000	0.38611523	88.80000000	2.68352941
UNIT=U2 CLASS=REC.								
CORD	47	0.95957447	0.80532456	0.10000000	3.20000000	0.11746866	45.10000000	0.64854764
UNIT=U2 CLASS=SEC.								
CORD	45	2.05777778	1.83185064	0.20000000	8.00000000	0.27307617	92.60000000	3.35567677
UNIT=U3 CLASS=MAJ.								
CORD	33	5.56060606	3.11015870	0	15.00000000	0.54140914	183.50000000	9.67308712
UNIT=U3 CLASS=REC.								
CORD	13	0.89230769	0.79105577	0.30000000	3.00000000	0.21939940	11.60000000	0.62576923
UNIT=U3 CLASS=SEC.								
CORD	34	2.83235294	2.15852371	0.50000000	8.00000000	0.37018376	96.30000000	4.65922460
UNIT=U4 CLASS=MAJ.								
CORD	41	5.72926829	3.60598419	1.00000000	18.00000000	0.56316012	234.90000000	13.00312195
UNIT=U4 CLASS=REC.								
CORD	16	0.58750000	0.55000000	0.10000000	2.00000000	0.13750000	9.40000000	0.30250000
UNIT=U4 CLASS=SEC.								
CORD	38	3.29736842	2.82321332	0.20000000	15.00000000	0.45798568	125.30000000	7.97053343
UNIT=U5 CLASS=MAJ.								
CORD	29	7.38275862	4.67241670	0.30000000	18.00000000	0.86764600	214.10000000	21.83147783

Sample DATA

PIE DISTRIBUTION OF VOLUMES USED FOR FIRST HOME BY UNIT

9:05 WEDNESDAY, SEPTEMBER

SUM PIE CHART OF CORD GROUPED BY UNIT



Sample DATA

NUMBER OF SAMPLES USED FUELWOOD BY SURVEY UNIT & USE CLASS
FOR EACH CELL: 1ST NUMBER FOR SAMPLES, 2ND FOR % OF TOTAL SAMPLES
3RD FOR ROW % & 4TH FOR COLUMN %

9:05 WEDNESDAY, SEPTEMBER 30, 1981

TABLE OF UNIT BY CLASS

UNIT / CLASS FREQUENCY PERCENT ROW PCT COL PCT	MAJ.	REC.	SEC.	TOTAL
U1	53 6.97 56.99 20.46	5 0.66 5.38 2.58	35 4.61 37.63 11.40	93 12.24
U2	18 2.37 16.36 6.95	47 6.18 42.73 24.23	45 5.92 40.91 14.66	110 14.47
U3	33 4.34 41.25 12.74	13 1.71 16.25 6.70	34 4.47 42.50 11.07	80 10.53
U4	41 5.39 43.16 15.83	16 2.11 16.84 8.25	38 5.00 40.00 12.38	95 12.50
U5	29 3.82 34.94 11.20	17 2.24 20.48 8.76	37 4.87 44.58 12.05	83 10.92
U6	38 5.00 42.22 14.67	19 2.50 21.11 9.79	33 4.34 36.67 10.75	90 11.84
U7	19 2.50 28.79 7.34	25 3.29 37.88 12.89	22 2.89 33.33 7.17	66 8.68
U8	19 2.50 25.00 7.34	28 3.68 36.84 14.43	29 3.82 38.16 9.45	76 10.00
U9	9 1.18 13.43 3.47	24 3.16 35.82 12.37	34 4.47 50.75 11.07	67 8.82
TOTAL	259 34.08	194 25.53	307 40.39	760 100.00

Sample Data

NUMBER OF PHONE CALLS USED FUELWOOD (FREQUENCY) BY UNIT

9:05 WEDNESDAY, SEPTEMBER

FREQUENCY BAR CHART

UNIT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
U1	93	93	12.24	12.24
U2	110	203	14.47	26.71
U3	80	283	10.53	37.24
U4	95	378	12.50	49.74
U5	83	461	10.92	60.66
U6	90	551	11.84	72.50
U7	66	617	8.68	81.18
U8	76	693	10.00	91.18
U9	67	760	8.82	100.00

10 20 30 40 50 60 70 80 90 100 110

FREQUENCY

Expanded Data

TOTAL FACILITIES USED BY FACILITY & USE CLASS

FACILITY NAME	USE CLASSES MAJOR	SUPPLEMENT	PLEASURE	TOTAL
STOV	175449	190181	24867	390497
R.F.	17605	255912	396802	670319
M.F.	32506	47562	18937	99005
FURN	36378	19727	1852	57957
S.RF	19059	45111	6505	70675
S.MF	0	6323	976	7299
S.FN	16525	601	0	17126
F.FN	4763	1363	0	6126
TOTAL	302285	566780	449939	1319004

FOR SURVEY UNIT# 1

FACILITY NAME	USE CLASSES MAJOR	SUPPLEMENT	PLEASURE	TOTAL
STOV	16863	10335	544	27742
R.F.	544	3264	2176	5984
M.F.	0	1088	0	1088
FURN	8703	2176	0	10879
S.RF	1088	2176	0	3264
S.FN	1632	0	0	1632
TOTAL	28830	19039	2720	50589

FOR SURVEY UNIT# 2

FACILITY NAME	USE CLASSES MAJOR	SUPPLEMENT	PLEASURE	TOTAL
STOV	31634	54640	8627	94901
R.F.	2876	43137	120783	166796
M.F.	2876	14379	5752	23007
FURN	8627	2876	0	11503
S.RF	2876	8627	0	11503
S.MF	0	5752	0	5752
S.FN	2876	0	0	2876
TOTAL	51765	129411	135162	316338

FOR SURVEY UNIT# 3

FACILITY NAME	USE CLASSES MAJOR	SUPPLEMENT	PLEASURE	TOTAL
STOV	8412	6609	0	15021
R.F.	601	7811	7210	15622
M.F.	1802	2403	0	4205
FURN	3605	601	601	4807
S.RF	3004	1802	0	4806
S.FN	1202	601	0	1803
F.FN	1202	601	0	1803

Expanded Data

TOTAL VOLUME ESTIMATED(IN CORDS) BY SPECIE & USE CLASS

SPECIE NAME	USE CLASSES MAJOR	SUPPLEMENT	PLEASURE	TOTAL
OAK.	196663.4	211623.6	42616.2	450903.1
BIR.	45188.2	18141.1	1719.3	65048.5
ASH	116608.4	35998.7	6672.7	159279.7
ELM	121300.5	35669.3	5744.6	162714.3
MAP.	258270.3	186105.7	31047.2	475423.2
ASP.	4246.7	3740.2	1623.9	9610.8
BASS	92564.9	47958.8	558.7	141082.4
MXDH	633751.6	514892.5	154677.9	1303321.0
HW#1	63765.7	114031.4	49691.6	227488.7
HW#2	47555.8	38687.1	5793.2	92036.1
HW#3	2061.5	7060.5	8801.4	17923.4
PINE	10887.5	11120.9	5593.6	27602.0
SP.F	4421.1	0.0	1348.6	5769.7
MXDS	41447.7	50042.5	15722.6	107212.7
TOTAL	1638729.0	1275069.0	331611.2	3245411.0

NOTE:MAP.=MAPLE,ASP.=ASPEN,BASS=BASSWOOD,MXDH=MIXED HARDWOOD,HW#1=OTHER HDW#1,SP.F=SPR.FIR, MXDS=MIXED SOFTWOOD

FOR SURVEY UNIT= 1

SPECIE NAME	USE CLASSES MAJOR	SUPPLEMENT	PLEASURE	TOTAL
OAK.	5722.5	0.0	108.8	5831.3
BIR.	7196.6	3481.4	108.8	10786.8
ASH	1087.9	0.0	0.0	1087.9
ELM	41450.1	13196.6	761.6	55408.2
MAP.	72466.9	21486.6	1686.3	95639.7
ASP.	1751.6	0.0	0.0	1751.6
BASS	24413.1	2175.9	0.0	26589.0
MXDH	90744.1	27176.5	734.4	118654.9
HW#1	8159.5	9301.8	54.4	17515.6
HW#2	13299.9	3155.0	0.0	16454.9
HW#3	1311.0	43.5	0.0	1354.5
PINE	4079.7	0.0	0.0	4079.7
MXDS	3182.2	5983.6	136.0	9301.8
TOTAL	274864.9	86000.6	3590.2	364455.6

FOR SURVEY UNIT= 2

SPECIE NAME	USE CLASSES MAJOR	SUPPLEMENT	PLEASURE	TOTAL
OAK.	8627.4	8627.4	6211.7	23466.4
BIR.	10180.3	5607.8	862.7	16650.8
ASH	22172.3	12365.9	575.2	35113.4
ELM	30080.7	862.7	0.0	30943.5
MAP.	41842.7	63238.5	12912.3	117993.4
ASP.	0.0	2875.8	0.0	2875.8
BASS	7074.4	16392.0	115.0	23581.5
MXDH	96741.4	107813.1	71405.5	275960.0

FOM 10/1/81

New York.

FUELWOOD SURVEY STATISTICS (USE CODING FORM:FORESTRY 1/20/81

STATE CODE=36 THE SURVEY YEAR=1981

TOTAL CORDS USED FOR 1ST HOME= 3245415.0 TOTAL VOLUME FOR 2ND HOME= 142855.4

TOTAL COMBINED= 3388270.0

ESTIMATED TOTAL REPRESENTED HOUSEHOLDS BURNED FUELWOOD IN THE STATE CODE=36 YEAR=81

SURVEY UNIT	USE CLASSES MAJOR	SUPPLEMENT	PLEASURE	TOTAL
1	28830	19039	2720	50589
2	51764	129411	135162	316337
3	19827	20428	7811	48066
4	7839	7265	3059	18163
5	16573	21144	9715	47432
6	37104	32222	18552	87878
7	23767	27520	31272	82559
8	58035	88580	85525	232140
9	58546	221175	156123	435844
TOTAL	302285	566784	449939	1319008

ESTIMATED TOTAL FUELWOOD VOLUME(IN CORDS) USED FOR FIRST HOME HEATING

SURVEY UNIT	USE CLASSES MAJOR	SUPPLEMENT	PLEASURE	TOTAL
1	274863.7	86001.8	3590.4	364455.9
2	255368.9	266298.9	129697.6	651365.3
3	110250.1	57859.3	6969.8	175079.1
4	44911.7	23955.4	1797.2	70664.2
5	122354.4	86347.5	10743.6	219445.5
6	218620.6	102915.0	12107.6	333643.2
7	125714.9	76680.7	16636.7	219032.2
8	279484.2	231835.1	68114.4	579433.7
9	208163.5	342170.1	81964.5	632298.1
TOTAL	1639731.0	1274063.0	331621.6	3245415.0